WHAT IS CLAIMED IS:

1. A method for detecting information relating to a pattern on an object to be inspected comprising the steps of:

focusing and irradiating an annular-looped diffusion illumination light formed with a plurality of virtual spot light sources onto a pattern on the object to be inspected through a pupil of an objective lens;

receiving an image of the pattern of the inspected object by focusing a first or second order diffraction light including a 0th order diffraction light which is reflected from the pattern on the inspected object by the focused and irradiated annular-looped diffusion illumination light and entered into the pupil of the objective lens; and

converting the received image of the pattern of the inspected object to image signals of the pattern for obtaining information relating to the pattern.

2. A method according to claim 1, wherein the image signals of the pattern provide information relating to a defect of the pattern.

3. A method according to claim 1, wherein the step of receiving an image of the pattern includes utilization of an image sensor, and further comprising the steps of comparing the image signals of the pattern of the inspected object with image signals of a reference pattern, erasing the pattern of the inspected object according to consistency of the received image signals and the image signals of the reference pattern,

and detecting a defect of the pattern according to an inconsistency.

4. A method according to claim 1, wherein at least one of the step of focusing and irradiating and the step of receiving includes utilizing a light quantity control filter for partly changing an intensity or a quantity of the first or second order diffraction light including a 0th order diffraction light entered into the pupil of the objective lens and reflected from the pattern, the step of receiving further includes utilizing an image sensor, and further comprising detecting the pattern on the inspected object according to the converted image signals of the pattern.

5. A method according to claim 4, further comprising the steps of comparing the converted image signals of the pattern with image signals of a reference pattern, erasing the pattern of the inspected object according to consistency of the received image signals and the image signals of the reference pattern, and detecting a defect according to an inconsistency.

6. A method according to claim 4, wherein the step of receiving includes utilizing a first image sensor, further comprising the steps of controlling the annular-looped diffusion illumination light according to image signals of the pupil obtained by receiving the image on the pupil of the objective lens with a second image sensor.

7. A method according to claim 6, further comprising the step of converting the image received by the second image sensor.

8. A method according to claim 6, wherein the steps of controlling include receiving with the second image sensor the image of a distribution of a locality of the diffraction lights including the 0th order diffraction light entered into the pupil of the objective lens.

9. A method according to claim 6, further comprising the steps of comparing the image signals of the pattern obtained from the first image sensor with image signals of a reference pattern, erasing the pattern of the inspected object according to consistency of the image signals received by the first image sensor and the image signals of the reference pattern, and detecting a defect of the pattern according to inconsistency of the compared image signals.

10. A method according to claim 8, further comprising the steps of comparing the image signals of the pattern obtained from the first image sensor with image signals of a reference pattern, erasing the pattern of the inspected object according to consistency of the image signals obtained from the first image sensor with the image signals of the reference pattern, and detecting a defect of the pattern according to inconsistency of the compared image signals.

11. A method according to claim 1, further comprising the step of detecting the pattern on the object to be inspected according to the converted image signals of the pattern.

12. A method according to claim 1, wherein the step of focusing and irradiating includes focusing and irradiating a polarization annular-looped diffusion illumination light formed by adding a polarization to the annular-looped diffusion illumination light formed with the plurality of virtual spot light sources onto the pattern, and detecting the pattern on the object to be inspected according to the image signals of the pattern.

13. A method according to claim 12, wherein the polarization is one of circular and elliptical polarization.

14. A method according to claim 1, wherein the step of focusing and irradiating includes focusing and irradiating a polarization annular-looped diffusion illumination light formed by adding a polarization to the annular-looped diffusion illumination light formed with the plurality of virtual spotlight sources onto the pattern, and further comprising the steps of comparing the image signals of the pattern of the inspected object with image signals of a reference pattern, erasing the pattern of the inspected object according to consistency of the image signals of the pattern and the image signals of the reference pattern, and detecting a defect of the pattern according to inconsistency of the

compared image signals.

15. A method according to claim 14, wherein the polarization is one of circular and elliptical polarization.

16. A method according to claim 3, further comprising the steps of receiving with the image sensor an image of an impurity on the pattern on the inspected object obtained by focusing a scattering light which is reflected from an impurity on the inspected object with a dark field illumination irradiated onto the pattern on the inspected object and entered into the pupil of the objective lens, converting the received image to the signals indicating the impurity, and detecting impurity information of the pattern.

17. A semiconductor substrate manufacturing method for manufacturing semiconductor substrates respectively having a pattern or patterns in a manufacturing line comprising various process units, comprising the steps:

performing history data or data based build-up by accumulating in advance of a present step of manufacturing information of a pattern defect which occurred on the semiconductor substrate and history data or a data base which indicates a correlation between a defect and a cause of defect or a factor of defect which incurs a defect of a pattern in the manufacturing line and building up the history data or the database which indicates the correlation;

performing defect inspection utilizing the method according to claim 1 for detecting defect information of a

pattern on an inspected object which is a semiconductor substrate, wherein the focused and irradiated annular-looped diffusion illumination light is irradiated to the semiconductor substrate which reaches a specified position on the manufacturing line, obtaining the converted image signals and comparing the received converted image signals of the pattern with image signals of a reference pattern for detecting defect information;

analyzing a cause of a defect or a factor of a defect which incurs a defect of the pattern in an upstream manufacturing line from the specified position of the manufacturing line according to the information of the pattern defect which occurs on the semiconductor substrate as detected and the history data or the database which is built up in the history data or database built-up step and indicates a correlation between the information of a pattern defect and a cause of a defect or a factor of a defect; and

controlling process conditions in the upstream manufacturing line for eliminating the cause of a defect or the factor of the defect which has been analyzed in the defect cause analyzing step.

18. A semiconductor substrate manufacturing method according to claim 17, wherein the inspection step includes controlling the annular-looped diffusion illumination light focused and irradiated onto the pattern on the semiconductor substrate, and receiving a high resolution image of the pattern.

19. A semiconductor substrate manufacturing method according to claim 18, wherein in the inspection step, the focused and irradiated annular-looped diffusion illumination light is controlled according to the image on a pupil of the objective lens.

20. A semiconductor substrate manufacturing method according to claim 17, wherein in the inspection step, the annular-looped diffusion illumination light which is focused and irradiated is a polarized annular-looped diffusion illumination light formed by adding polarization to the annular-looped diffusion light.

21. A semiconductor substrate manufacturing method according to claim 20, wherein in the inspection step, the polarized annular-looped diffusion light is one of circular and elliptical polarization.

22. A semiconductor substrate manufacturing method according to claim 17, further comprising an impurity inspection step for detecting an impurity on the pattern by irradiating a dark field illumination onto the semiconductor substrate which has reached the specified position on the manufacturing line, receiving an image of an impurity of the pattern of the inspected object obtained by focusing a scattering light which is reflected from an impurity on the pattern of the inspected object and entered into the pupil of the objective lens with an image sensor, and converting the received image signals indicating the impurity, the analyzing

step including analyzing a cause of at least one of a defect and impurity or a factor of at least one of a defect or impurity which incurs a defect or an impurity of the pattern in the upstream manufacturing line from the specified position of the manufacturing line in accordance with the defect information of the pattern detected in the defect inspection step and the impurity information of the pattern detected in the impurity inspection step and the history data or the data base which is built up in the history data or data base build-up step and indicates the correlation of causes and results, and the controlling process conditions step includes controlling process conditions in the upstream manufacturing line for eliminating the cause of at least one of the defect and impurity or a factor of at least one of the defect and impurity analyzed in the at least one of the defect and impurity cause analyzing step.

23. A pattern detection apparatus for detecting a pattern on an object to be inspected, comprising:

illumination means for emitting an annular-looped diffusion illumination light formed with a plurality of virtual spot light sources;

an illumination optical system for focusing and irradiating the emitted annular-looped diffusion light onto a pattern on an inspected object through a pupil of an objective lens; and

a detection optical system for receiving with an image sensor, an image of the pattern on the inspected object obtained by focusing a first or second order diffraction light

including a 0th order diffraction light which is reflected from the pattern on the inspected object by the focused and irradiated annular-looped diffusion illumination light from the illumination optical system and entered into the pupil of the object lens, and for converting the received image of the pattern to image signals of the patter for obtaining information relating to the pattern.

24. A pattern detection apparatus according to claim 25, further comprising comparison means for comparing the converted image signals of the pattern with image signals of a reference pattern;

means for erasing the pattern of the inspected object according to consistency of the received converted image signals and the image signals of the reference pattern; and

means for detecting a defect according to an inconsistency.

25. A pattern detection apparatus according to claim 24, wherein at least one of the illumination optical system and the detection optical system includes a light quantity control filter for partly changing the intensity or the light quantity of the first or second order diffraction light, including the 0th order diffraction light which is reflected from the pattern.

26. A pattern detection apparatus according to claim 25, wherein the detection optical system includes the light quantity control filter for partly controlling the light

quantity of the 0th order diffraction light which is reflected from the pattern.

27. A pattern detection inspection apparatus according to claim 23, wherein the detection optical system includes means for enabling variable optical magnification therein.

28. A pattern detection inspection apparatus according to claim 23, further comprising a pupil detection optical system for receiving with another image sensor, the image on the pupil of the objective lens from the another sensor and for converting the received image to image signals of the pupil; and

control means for controlling the annular-looped diffusion illumination light emitted by the illumination means according to the image signals of the pupil obtained from the another image sensor of the pupil detection optical system.

29. A pattern detection apparatus according to claim 28, wherein the detection optical system includes means for varying optical magnification therein.

30. A pattern detection apparatus according to claim 23, further comprising a pupil detection optical system for receiving with another image sensor a distribution of locality of diffraction light including the 0th order diffraction light and for converting the received image to image signals of the pupil; and

control means for controlling the annular loop diffusion

illumination light emitted by the illumination means according to the image signals of the pupil obtained from the another image sensor of the pupil detection optical system.

31. A pattern detection apparatus according to claim 30, wherein the detection optical system includes means for varying an optical magnification therein.

32. A pattern detection apparatus according to claim 23, wherein the illumination optical system includes polarization means having polarization conversion optical elements for adding polarization to the annular-looped diffusion illumination light emitted from the illumination means.

33. A pattern detection apparatus according to claim 32, wherein the polarization means includes one of circular and elliptical polarization conversion optical elements for applying one of circular and elliptical polarization to the emitted annular-looped diffusion illumination light.

34. A pattern detection apparatus according to claim 23, further comprising another illumination optical system for irradiating a focused dark field illumination to the pattern on the inspected object, another detection optical system for receiving light from an impurity on the pattern on the inspected object obtained by focusing a scattering light which is reflected from the pattern on the inspected object irradiated by the another illumination optical system and entered into the pupil of the objective lens, and for

converting the received light to signals indicative of the impurity, and further comprising comparison means for comparing the image signals of the pattern obtained from the detection optical system with image signals of a reference pattern, means for erasing the pattern of the inspected object according to consistency of the image signals of the pattern and image signals of the reference pattern, and means for detecting a defect of a pattern according to an inconsistency, and impurity detection means for detecting impurity information according to the signal obtained from the another detection optical system.

35. A pattern detection apparatus according to claim 34, wherein the illumination optical system includes polarization means for adding polarization to the annular-looped diffusion illumination light emitted by the illumination means and including polarization conversion optical elements.

36. A pattern detection apparatus according to claim 35, wherein the polarization means includes means for adding one of circular and elliptical polarization and including one of circular and elliptical polarization conversion optical elements.

37. A pattern detection apparatus according to claim 23, wherein the pattern detection apparatus is part of a microscope system.

38. A pattern detection apparatus according to claim 23,

wherein the pattern detection apparatus is part of a manufacturing system for manufacturing semiconductors and the object to be inspected is a semiconductor substrate having the pattern thereon.

39. A pattern defect inspection apparatus for detecting a defect of a pattern on an object to be inspected comprising:

illuminating means for irradiating a uniform illumination light in a detection field of an object to be inspected through an objective lens;

image detection means for detecting and converting a reflected light from the inspected object to an image by photoelectric conversion; and

image comparison means for comparing the detection image with a reference image.

40. A pattern defect inspection apparatus according to claim 39, wherein the image detection means includes pupil image detection means for forming an image on the pupil of the objective lens through a lens and for detecting the image thereof.

41. A pattern defect inspection apparatus according to claim 39, further comprising polarization state control means for controlling a state of polarization of the illumination light emitted by the illuminating means.

42. A pattern defect inspection apparatus according to claim 40, further comprising polarization state control means

for controlling a state of polarization of the illumination light emitted by the illuminating means.